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ABSTRACT

Focusing on interactive, computer-based systems and external, long-distance instruction transmitted from one or more satellite earth stations, this paper begins by citing the need to experiment with and develop new delivery systems that will increase productivity in both teaching and learning. The use of satellite technology in Utah and Texas is discussed, as well as Washington State's program, "Satellite Telecommunications Educational Programming" (STEP). It is noted that computer-assisted instruction, computer-managed instruction, and other uses of computers in the classroom: (1) are not uniformly implemented as instructional innovations; (2) vary in effectiveness as teaching/learning tools; (3) vary in cost effectiveness; (4) are not always accessible to all groups of students; and (5) require systematic, sophisticated, and long-term inservice training of teachers, as well as a reworking of the scope and sequence of school curricula, in order to reach their potential. The relationship between educational technology and state educational agencies is discussed, particularly in terms of access to and quality of education; the extent to which the state regulates school governance; teacher certification; school accreditation; and the state-operated infrastructure that supports public education. (16 references) (DB)

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ACCESS, QUALITY AND ECONOMY: THE UNFINISHED AGENDA FOR AMERICA'S SCHOOLS

(Education Technology and Higher Literacies)

J. Quentin Jones

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The Education Commission of the States is a nonprofit, nationwide interstate compact formed in 1965. The primary purpose of the commission is to help governors, state legislators, state education officials and others develop policies to improve the quality of education at all levels. Forty-eight states, the District of Columbia, American Samoa, Puerto Rico and the Virgin Islands are members. The ECS central offices are at 1860 Lincoln Street, Suite 300, Denver, Colorado 80295. The Washington office is in the Hall of the States, 444 North Capitol Street, Suite 248, Washington, DC 20001.

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The National Conference of State Legislatures is designed to help lawmakers and their staffs meet the challenge of today's complex federal system. Its Office of State Services is located in Denver, Colorado; its Office of State-Federal Relations is located in Washington, D.C. NCSL serves the country's 7,461 legislators and their staffs. It is funded by the states and governed by a 54-member Executive Committee. NCSL has three basic objectives:

- To improve the quality and effectiveness of state legislatures;
- To foster interstate communication and cooperation; and
- To ensure state legislatures a strong, cohesive voice in the federal system.

ACCESS, QUALITY AND ECONOMY: THE UNFINISHED AGENDA FOR AMERICA'S SCHOOLS

J. Quentin Jones

Achieving excellence in American education has become a goal nationwide. Yet, overwhelming evidence exists to support the contention that many students, both majority and minority, are not taking courses appropriate to their ability, while still others are denied access to a challenging curriculum.

In the foreseeable future it is not likely that state education agencies or local school districts will have large amounts of new money to support and sustain excellence reforms. Significant improvements in public education will of necessity require renewed attention to the application of telecommunications technology by the states and local school districts. This paper calls for accreditation, certification, rule-making and legislative agencies to carefully and vigorously examine the important policy issues with respect to the application of technology to schooling. There is also the need to aggressively experiment with and develop new delivery systems that cut across both school and school district boundaries in order to bring about a more uniform level of quality in elementary and secondary education and increase the productivity in both teaching and learning.

Telecommunications instruction may be thought of as any course of instruction which has as its primary means of delivery satellite up-links and down-links, computers, television, videotape and cassette, laser disk, film, radio or other devices which employ the audio-video format. In some instances, telecommunications courses are supported by study guides, library resources ans textbooks, and may also involve

student interaction with faculty, tutors or other educational personnel by telephone, mail or face-to-face meetings.

This paper will not undertake a detailed review or a prolonged essay regarding the older, familiar technological devices and techniques. It will concentrate instead on interactive, computer-based systems and external, long-distance instruction transmitted from one or more satellite earth stations using one or more private or public satellites whose transmission is licensed with the Federal Communications Commission (FCC) and which are frequency coordinated.

William Chance, in writing about innovation and reform in education, noted that "the reforms of the 1980s to this point have been something less than liberally spiced with innovation. First, the present reforms have stressed accountability through testing, management, evaluation and requirements. The actual business of conveying knowledge has been pretty much left alone."[1]

The Carnegie Corporation of New York, in its 1984 Program Statement, noted that "while science and technology have transformed much of our society, they have had little impact on the education system."[2] "And in 1986, the Society of Applied Learning Technology after concluding that technology-based systems improve learning and are cost effective, suggested that the traditional labor-intensive educational methods are unlikely to enable the United States to achieve optimum human resource productivity in the learning process."[3]

In his report on the National Governors' Association's (NGA) Task Force in Technology, Governor John Sununu of New Hampshire stated that "despite more than a billion dollars in purchases and an incalculable amount in donations nationally

during the past few years, schools have generally not become more productive through the use of technology."[4]

In its August 1986 report, NGA also identified the paucity of research with respect to those technologies which have the potential to create enhanced educational productivity and to the decentralized nature of public school systems. The report noted that none of the major educational associations has actively supported the concept of long-distance learning.

The use of satellite technology to deliver instruction to rural areas was the subject of three limited experiments between 1972 and 1976. This activity made use of three Applications Technology Satellites to provide daily instruction in the language arts, career education, decision making, health and emergency medical training. Continuing professional development programming for teachers was produced and transmitted to rural schools to support student programming. The experiments demonstrated the delivery of data and high-speed facsimile of curriculum and research information and determined that quality instruction could be attractively and effectively delivered to rural audiences and reliably and cost-effectively with satellites.

The Federation of Rocky Mountain States began as early as 1965 to explore the possibility of satellite-based education. The first satellite for educational television was launched from Cape Canaveral, Florida, in May 1974 with funding and support from the National Institute of Education; the U.S. Department of Health, Education and Welfare; and the National Aeronautics and Space Administration. Fifty-six rural schools in eight western states composed the primary student audience.

In September 1985, the Utah State Department of Education, with support from the Bonneville Corporation and IBM, began daily intensive, accelerated Spanish

instruction for grades 6 to 10 in Utah's public schools by satellite. Currently schools in Colorado, Nevada, New York, Georgia, North Dakota and Arkansas also participate. The Utah program uses master teachers and classroom managers who do not have to speak Spanish. The technology includes interactive television, satellite distribution of instruction and microcomputers equipped with digitized voice capability and speech recognition. For a basic site license fee, the user is provided 88 lessons by satellite, 20 software disks and inservice training activities. Early results indicate that students are learning two years of conversational Spanish in one year.

In Texas, the InterAct Instructional Television Network began broadcasting in September 1983 and added high school instruction in January 1984. The network uses closed circuit microwave technology which sends both audio and video signals from the Texas Education Association's Region IV Instructional Services Division in Houston.

To help public and private schools meet legislatively mandated school reforms and cope with teacher shortages, the Texas Education Agency recently joined the rapidly expanding TI-IN Network Inc., a private satellite network that sells instruction in a variety of subjects and provides credit courses plus enrichment activities for high school students and inservice teacher training programs.

Many rural Texas schools, unable to meet the requirements of H.B. 72, the state's major school reform bill, have avoided closure or consolidation as a result of being able to offer advanced academic classes which they otherwise would have been unable to do. While TI-IN serves primarily small rural schools, it is no less appropriate for many urban and suburban schools that wish to upgrade their academic courses and/or practice cost-containment procedures.

Based in San Antonio, TI-IN currently beams its daily programming to schools in Texas and 23 other states. Employing a combination of satellite telecommunications and word processing technology, students are able to see, hear and talk to their instructor as well as converse with their peers around the nation. In many of the participating schools, an adult volunteer monitors the satellite classes.

The average cost to a school wishing to link-up with TI-IN is approximately $20,000. That includes a satellite dish, receiver, monitor, printer and videocassette recorder plus subscription and program fees. In the second and succeeding years, the annual cost drops to $13,000. Operating costs have been calculated at slightly more than $200 per student per semester hour.

In 1986, Eastern Washington University, in cooperation with the Board of Cooperative Educational Services (BOCES) in Spokane, launched the Satellite Telecommunications Educational Programming network (STEP), providing high school courses to 15 schools. STEP has many similarities to the TI-IN Network but broadcasts only four days per week as opposed to five. Rural school districts in Wisconsin can participate in two-way, live instruction by the Western Wisconsin Communications Cooperative. The College of Arts and Sciences at Oklahoma State University operates a satellite-based, teleconferencing network offering courses in physics, German, trigonometry and Advanced Placement (AP) calculus, chemistry and American history and government for the public schools in that state. Since 1980, Alaska has provided satellite-based, televised instruction to its many rural schools. Learn Alaska's Satellite Network, until it was terminated by state funding cuts, was linked to a statewide audiconferencing system. It provided not only instructional programs for classroom use but also college-level courses, inservice training, staff

development and educational outreach activities. The audio-conferencing network is now operating under the aegis of the University of Alaska, while Anchorage Community College directs the instructional television network.

A recent study conducted by the Massachusetts Institute of Technology "showed that traditional classroom instruction was the only one of nearly 20 communications media studied whose productivity actually declined during the past two decades -- all others grew either steadily or explosively."[5] Research done on the effectiveness of curriculum-based computer systems such as Dolphin, Plato, MicroHost and WICAT clearly showed that students using these systems learned more, not less, than students engaged in the traditional teaching/learning environment.[6]

Other studies of the cost-effectiveness of computer-assisted instruction (CAI) have focused upon its use to enhance the development of basic skills. Here the technology has a proven track record. "TURNKEY Systems, Inc. found that the average cost of classroom instruction in elementary and secondary schools is $1.25 per student hour; equivalent computer-based instruction costs $1.10 per student/hour and the cost gap is steadily widening as schools grow more expensive while computer technology rapidly gets cheaper."[7] Further evidence that using telecommunications is cost effective can be found by examining Sesame Street, the highly successful children's television program where, because of nationwide coverage, the cost became one cent per viewer/hour."[8]

However, the limited amount of available research has yet to prove that the use of a word processor enhances the quality of writing or that skill at programming a computer enhances mathematical ability. While it is generally agreed that computers and educational software designed for use as a tool in writing (word processing), drill,

practice and remediation is effective and can help students learn, the jury is still out on whether CAI produces students who have the ability to write and read at an advanced level. The recent popularity and overuse of the term "literacy" carries with it the inference that putting the power of a computer or word processor in the hands of a student somehow conveys to the user skills that are equivalent to those required for effective reading and writing. The danger here is one of taking a term from one context and applying it in a new and inappropriate context since most computers are merely word processors, unable to correct faulty logic or even poor grammar.

Among the many technological advances available and applicable to education, satellite telecommunication methods are clearly able to distribute instruction that is distance-insensitive and directly responds to the central issues of quality, economy and access. Replicability of such instruction from school to school requires only the installation of a low-cost earth station and the acquisition of supporting printware. Given the size of the educational establishment and the fact that telecommunications technology is almost as old as the ocean's roar, one wonders why so few states and agencies have seized the opportunity to improve learning by means of proven, cost-effective systems.

In the opinion of Sununu and the NGA's Task Force on Technology, "not enough school districts are planning for the use of technology. One recent study found that, while 96% of U.S. school districts were using various kinds of technology to improve instruction, only 14% had developed policies about how they planned to use the technology."[9]

Although CAI is wide-spread and microcomputers are found in most schools, there is little documentation to support the contention that CAI is more effective than

other instructional methods. In fact, "the instructional effectiveness of the techniques used in CAI is rarely addressed, nor are programs often judged on how much students learn from using them."[10] Is it possible that the meteoric popularity of micro-computers during the years 1983-85 was a politic response by the schools to satisfy national, state and local calls for computer literacy?

Any examination of the cost-effectiveness of computer-assisted instruction suffers from the ability to standardize input elements. Schools differ dramatically in terms of their instructional goals, resources available and the training and proficiency of the staff using the hardware and software. However, one carefully documented study of computer-assisted instruction found that CAI was somewhat more cost-effective than three of five other instructional methods examined. Levin and Meister[11] noted that in arriving at the cost-effectiveness of CAI the initial cost of the hardware is only the tip of the iceberg and, by itself, may be misleading. Other costs such as facilities, software, personnel, training programs, maintenance and support services must be factored in over time. Even if the hardware is donated, that only reduces the overall cost of CAI by 11%.

The National Assessment of Educational Progress (NAEP) surveyed the nation's schools during the 1985-86 academic year with respect to students' knowledge and skills in using a computer.[12] Among the findings was that the use of computers by students in middle and high schools is confined largely to computer studies courses. As a result, computer use by students in other areas of the curriculum is minimal. Furthermore, NAEP's first assessment of computer competence found that black and Hispanic students have less exposure to computers than do their Anglo counterparts, in large part because of out-of-school opportunities. In fact, the assessment data show

that having access to a personal computer at home provides a student more significant advantages in terms of competency than having access to a computer at school.

These findings confirm what earlier but more limited research found -- namely, that there is confusion about how to integrate CAI across the secondary school curriculum, that many instructors have minimal training in computer studies, and that computers are seldom used in such critical areas as reading, writing, mathematics or science. And it is in precisely areas such as these where the development of higher-order thinking skills is apt to be an instructional goal.

It is interesting to note that as of 1984 five states plus the District of Columbia required computer training as part of their teacher certification program, while 18 more either had legislation pending to require it or had the issue under study.[13] And the U.S. Department of Education's Office of Educational Research and Improvement reported in 1986 that data collected in a 1983-84 survey revealed that roughly nine of 10 schools of education gave prospective teachers some access to computers in the course of their training, and that 42% of the undergraduate schools of education offered courses which were described as related to computer-assisted instruction.[14]

A 1985-86 survey of 571 high school principals by the Association for Supervision and Curriculum Development (ASCD) examined the extent of the use of technology in school management. ASCD found that computers were used in 87% of the schools for compiling class lists, in 83% for class scheduling, in 76% for word processing, in 75% for recording grades and in 72% for keeping track of student attendance.

The principals surveyed by ASCD also identified videotape or cassette players as the most important items in their arsenal of educational technology. Only 10% of the schools put television usage at the top of their lists.

When asked why educational technology was not used more outside of administrative offices, the principals' responses were (in order of importance): budget limitations, lack of staff training, uncertainty about its place in the curriculum, lack of instructional materials and lack of teacher interest.[15]

While microcomputers do play an increasingly important, cost-effective role as a managerial tool in administration and departmental offices, the use of micro-computers in the classroom fizzled, according to researcher Stanley Pogrow, "because the advocates and the so-called experts knew little about the internal structure and administration of schools or, more importantly, the learning process. Of the hundreds of books published on programming and computer literacy, there was only one on using computers to enhance learning."[16]

The Educational Technology Center at Harvard University has identified two critical issues with respect to the implementation of technology at the school and classroom level. First, teachers and administrators underestimate the logistical problems inherent in establishing the conditions that must precede the introduction of technology in the teaching/learning process. Too many teachers believe their missions to be the transmission of knowledge as presented in textbooks. As a result, the second hurdle in integrating technology and/or externally designed courses into the curriculum is the realization that it will alter familiar, traditional teaching styles and will require changes in course content, materials, classroom routines and the role of the teacher.[17]

Among the slowly but steadily growing list of innovators is one Orange County, California, school district which has produced a "Technological Strategic Plan" to use educational technology to improve learning, enhance inservice training for teachers and to assist in decisionmaking with respect to the purchase and production of software, etc. This district envisions teachers as resource and information facilitators -- not information givers. From a central work station in the classroom, the teacher monitors instruction delivered by satellite, laser disks, computers, video-cassettes and closed-circuit television. This innovation has fostered interest and participation by private industry, most notably AT&T, Extron Electronics and the National Information Utility.[18]

Perhaps on-going research may well lead to the conclusion that, using what professional educators now know about the way students think and learn, group instruction may be the best means by which to develop an advanced level of literacy and higher-order thinking skills. Indeed, there are classrooms where the interactions of teacher and students and the pooling, sharing and testing of ideas occur. But even here, in a classroom with diverse student abilities or in small classes, a limiting factor is present. All students may or may not have the ability or the skills necessary for complex thought or reasoning.

Indirectly, then, education technology may change what teachers must know about their subject and may force teachers to expand the range and sophistication of their teaching techniques. Evidence derived from the schools employing the Higher Order Thinking Skills (HOTS) Program pioneered by Pogrow of the University of Arizona suggests that using computers with elementary school students can improve thinking ability and enhance academic performance. The richer and more

comprehensive the interactive elements, the greater the outcomes of learning. The keys here are the absolute necessity for systematic, sophisticated and long-term inservice training of teachers, a reworking of the scope and sequence of the curriculum and extensive computer use by each student.

The concern of American business and industry with respect to the level of skills new hires bring with them has been often expressed, and the Business Council for Effective Literacy reminds us that 27 million Americans over 17 years of age are functionally illiterate and another 45 million are marginally illiterate. To illustrate, the council noted that last year the New York Telephone Company administered tests to all job applicants for entry-level positions ranging from operators to service representatives. Of the 22,880 who took the tests covering vocabulary, number relationships and problem solving, only 3,619 passed -- a failure rate of 84%.

Will the next generation of workers be better prepared for jobs with the New York or any other telephone service? Data from three NAEP surveys provide evidence that young Americans are not learning to reason, read or write with more than superficial understanding.

As the nation becomes more dependent on electronic and technological devices, there is a concern for the ability of current and future students to deal with thought-provoking questions and to integrate reading and writing with reasoning. Indeed, the National Council of Teachers of English and the Modern Language Association fear that the wide-spread lack of reasoning skills is due in large part to society's obsession with visual, non-verbal media and images. Can a child who grew up watching Sesame Street and the Electric Company in living color cope with elementary school that comes on in black and white? Will teachers of reading and writing be able to rely

on print-oriented methods and materials to provide learners with the keys to the kingdom of basic and advanced literacy?

Turning to the supply side of instructional telecommunications, one notes that, with a few exceptions, manufacturers of hardware and software systems find that, unlike industry, no significant market exists in the schools for their products. The multiplicity of the schools and school districts (90% of which are fiscally independent) and the absence of statewide policies which cut across district or even state boundaries relative to the use of educational telecommunications defeat meaningful marketing and installation of compatible systems. Some software manufacturers say that schools don't know how or where to use their products, making it difficult to design effective programs. Meanwhile, technological developments are moving ahead rapidly and the producers of educational software need a standardized system and the ability to deliver their product to large audiences to achieve optimum benefits. As a result, dissimilar units and programs are in use (and disuse) across the country.

In spite of experiments and innovations, there is still a tremendous legacy in the schools for textual materials and the traditional teaching/learning format. Most classrooms in the United States are unchanged despite the expenditure for educational technology. Teachers still lecture, use a single textbook, out-talk students three to one, administer unscientific multiple-choice tests from time to time and ask questions that are not open-ended. Learning is nearly always a matter of passive intake of information by the student.

What barriers stand in the way of accelerating technology-based learning? What incentives can be provided to free public schools from the bonds that tie them to the past?

ACCESS AND QUALITY

The school financial policies of many states and the budget process of school districts reflect the concept of the classroom unit value or a derivative thereof which serves to perpetrate the practice of large-group, locally conceived instruction. Issues of access and equity have been almost without exception addressed by making changes in the existing school finance formula, which in turn has its heritage in the assumption that teaching and learning cannot occur unless the instructional program is initiated and carried out within individual classrooms. Furthermore, the distribution of school transportation funds has been based upon the notion that students must be brought to the site of instruction; that instruction is not transportable beyond individual classrooms.

As a result, if a school district is unable to hire or retain the personnel to teach a course or a sequence of courses in science, advanced mathematics or foreign languages, school finance techniques are of little help and students are denied exposure to the content such a course or courses would have provided.

Seven states have pioneered the relationship between the state's educational agency and educational technology with the intent to equalize the learning opportunities for students. Delaware created its "State Plan for the use of Computers in Education" in 1976, and as recently as May 1986, the Delaware State Board of Education authorized the expenditure of $20,000 for a study of higher-order thinking skills. Minnesota, in 1973, created and funded the Council on Quality Education Projects which included the Minnesota Educational Computing Consortium. Since then the state has moved ahead dramatically to research and produce educational

courseware, fund technology utilization planning efforts, support inservice training for educators and establish 20 technology demonstration sites.

In 1975, North Dakota's legislature passed a resolution to study the concept of a statewide computer system. In 1977, Alaska's legislature authorized the Educational Telecommunications for Alaska project, and Florida formed the Florida Educational Computing Project. Two years later, North Carolina mounted a task force on educational technology, and Ohio created and funded the Ohio Computer Education Network.

What changes then might be expected in the traditional concept and application of state school finance programs if widespread use of instructional and communication technology was implemented? Will there be increased access to uniform and/or quality instruction? Would there be changes in the time-honored capital investment policies of most school districts? What changes might occur with respect to the traditional labor-intensive form of instruction? Would the expanded use of technology have a positive effect in terms of increased financial support of instruction by the private sector?

GOVERNANCE

While the extent to which school governance is regulated varies greatly from state to state, the overarching principle has been the maintenance of local control in matters of curriculum, selection of instructional materials and employment of staff. California and New York have long been leaders in the centralization of public education, and Florida seems to be following in their footsteps. On the other hand, states such as Michigan, Ohio, Indiana and Colorado delegate much authority to their local boards. Regardless of the pattern of control, except for the adoption of

textbooks, instructional technologies have never influenced governing practices or policy.

Were school districts to adopt and employ communications technologies in the external delivery of instruction, the nation would take a significant step toward the formation of instructional technology. That, in all likelihood, would significantly challenge the governance and control habits of the schools, particularly those affecting the origin, packaging and delivery of instruction.

Is it possible that by using technology to enhance equity and equality, retaining small schools would be a more acceptable solution to the public and to legislators than school consolidation? What would be the effect of widespread use of instructional and communications technology on the locus, the level and the manner in which decisions are made and governance is exercised in the public schools? Would the use of instructional technology radically shift school governance and control to agencies and/or individuals beyond established school district boundaries, and, if so, to what effect? Would instructional technology raise questions about the organization, operation and size of existing school districts?

TEACHER CERTIFICATION

Historically, public education has depended in large part on the training and certification of those individuals thought to be capable of designing and delivering instruction to the young in such a way as to insure a quality education. Any proposal to apply technology to instruction is sure to be seen as an attempt to remove the design and delivery process from the control of the classroom teacher. If the scope and sequence of a course or courses of study and the point-of-use applications of such course content were to be delivered by technology, the teacher's traditional role would

surely be altered and states would face the question of whose professional competencies should be certified. The essence of technologically oriented instruction is the critical and vital design of the instructional system. Much less effort and attention needs to be directed to the classroom implementation aspect. What skills are required to do this? Could the certification process be shifted from input to output and base teacher certification on measurable outcomes of instruction rather than the presumed competency of one prepared to teach?

If greater and greater amounts of instruction are designed outside the classroom or even the school district, what then is the classroom teacher's role? Will the function of the classroom teacher become one of discussion leader, counselor, diagnostician and skill builder, while technology's role becomes the actual delivery of instruction? Would the use of technically designed instruction enhance or diminish a teacher's opportunity to take advantage of the career-ladder opportunities emerging? What course of action will certification agencies take to endorse and approve the use of technical systems of instruction in the public schools?

ACCREDITATION

In much the same way that teacher certification has been based on input measures, public school accreditation has also relied on such input factors as the physical presence of a qualified teacher in the classroom and quantitative elements such as the student-teacher ratio or the number of volumes shelved in the school library. Accrediting associations also are concerned with such elements as the scope and sequence of the curriculum and adequate guidance and counseling services.

The terms "teacher" and "qualified certificated human" as being physically present in the classroom directing instruction are assumed to be synonymous, but the

use of educational and communications technology suggests that we need to re-examine the definition of "teacher". A well-conceived, sequentially packaged computer software program in elementary algebra embodies most of the properties of a teacher, at least in the delivery and presentation of course content. It matters not at all if the computer mathematics program was designed in California and used in Colorado.

Yet, in most states the law requires that a classroom must be supervised by a professionally trained, certified teacher for the purpose of delivering instruction and maintaining an orderly learning environment. Even if one accepts the technical ability to deliver instruction from a site far removed from the classroom, the issue of classroom control still comes up.

One outcome of such experiments as the University of Pittsburgh's Individually Prescribed Instruction program during the 1960s and early 1970s was the realization that a subject-matter specialist need not be physically present in the classroom to maintain order. Those tasks were adequately performed by teachers' aides with minimal training. This staffing pattern tends to support the contention that the use of technology enhances the climate for differential staffing, thereby making greater use of a school's professional personnel. However, given the traditional orientation and perception of a teacher, school organization and staff development, it is highly unlikely that teacher organizations or accrediting agencies will welcome an innovation of this kind.

One obvious characteristic of technology is that it makes instruction visible. That is, unlike instruction that occurs in a self-contained classroom, instruction that occurs by means of television or satellite is observable by anyone either in or out of the school building who has access to cable or to broadcast television programming.

As a result, teachers, administrators, parents and other school patrons are given the opportunity to view instruction being delivered to students without being physically present in the classroom.

Does instruction which is primarily didactic require the physical presence of a credentialed, subject-matter teacher in every classroom? Does long-distance instruction via technology provide the means whereby the curriculum of a small, rural or isolated school can be immeasurably broadened and extended? Do the present laws, regulations and rules inhibit or permit the use of long-distance instruction in the schools? What approval, state authorization and non-governmental accreditation procedures are necessary to permit both inter- and intrastate distribution of instruction to public schools? What kinds of assessment are best suited for the evaluation of instruction delivered by technological means?

What kinds of student support systems will be needed in schools or school districts that receive instruction from a distance? What responsibilities will states and local school districts have in terms of insuring patron's informed access to technologically delivered courses? Would a statewide telecommunications network encourage more interaction between the faculties and administrators of public elementary and secondary schools and colleges? If public schools and colleges develop courses using state monies, are they free to sell the courses or associated instructional services to educational institutions in other states? Who owns the rights to such courseware? Does the act of transmitting an educational program into another state constitute a physical presence in that, state making it subject to state accreditation and supervision?

INFRASTRUCTURE

States have traditionally enacted protective legislation to safeguard the health and safety of their citizens and to permit the orderly conduct of business. One of the primary tasks of a state is to provide for the operation of inter- and intrastate commerce. Public roads, highways, bridges, water and sewage facilities and electrical transmissions systems are either supported or protected by state governments. Can it then be argued that since the traditional method of teaching and learning in the public schools is a state function that the creation, operation and supervision of a telecommunication infrastructure for educational purposes is also a state function?

Historically, the purpose of education appears to be a service of the state under the rubric of the state's well-being. The courts have interpreted public education to be the state's means of protecting itself from the consequences of an ignorant and incompetent citizenship. The use of telecommunications technology in delivering improved instruction and a comprehensive curriculum to all schools could significantly bring about improved productivity on the part of schools and move the nation beyond the point of simply maintaining the current systems of instruction at ever-increasing costs without a corresponding improvement in efficiency.

Business and industry have used computers and related materials for decades in worker training and retraining programs. Within the last several years, more interactive systems have replaced the older techniques. Today, more than one-third of U.S. companies with 50 employees or more use interactive computer programs in employee training, and the cost-effectiveness of such inservice training is most notable where employees are scattered over a wide geographical area.

Interactive computer systems are also assisting physicians and hospitals in diagnosis, treatment, inservice training for doctors and nurses and patient information and education. Because of the rapidly changing nature of technology and its expansion in the work place, Chester E. Finn, Jr., assistant secretary for educational research with the, U.S. Department of Education, has noted that any one of several major corporations could, overnight, create a company school that would employ all the technological advances now available.[19]

Does the present system of education promote a state's political and economic well-being when many schools and school districts are unable to provide a totally comprehensive and challenging curriculum to their pupils? Has the extension of equal education opportunity to all students wherever they may live been achieved? Would the use of telecommunications technology, in delivering improved instruction and a more comprehensive curriculum to the schools, provide a more equitable education and deliver more productive teacher training than is currently possible?

Since many schools use WATS lines or dedicated telephone lines for teleconferencing or computer linkages, does a state have a responsibility to govern by public utility regulations the transmission of instruction by these means? Does a state have the responsibility to provide, support and insure a telecommunication infrastructure for use by its educational agencies and institutions? Would such a system make active participation in education more attractive to business and industry? Would such a statewide educational telecommunication system and the institutions it serves need to be governed by public utility regulations?

CONCLUSION

Of course, the use of educational technology by schools does some good, and there is obviously much going on than is discussed here. But getting a clear picture is difficult.

Because of the decentralized nature of American education, none of the current efforts serve a broad enough area or encompass the diverse student population found in urban, rural and in-between communities. In actual practice, weaning the schools from old, entrenched practices is like moving a cemetery. Traditional teaching/learning practices exist because teachers, school administrators and collegiate schools of education need them. They guarantee job security, prestige and ego gratification. It's what teachers experienced as students. But that by itself does not mean that those earlier practices should continue. If one accepts that premise, no course of study, no program and no procedure would ever be changed or abolished. By preserving in the schools the least productive practices, those involved diminish the effectiveness and the economy of newer methods.

Finn has called for the use of technology to individualize instruction, appraise student performance and free teachers from record-keeping and other bureaucratic chores. He also observes that lessons taught by truly great teachers can be taped and shown to students anywhere and, by means of interactive video systems, Advanced Placement classes provided in one school can simultaneously be taken by other students in other schools.[20]

The use of technology and information are critical factors in the health of the nation's economy. Wisely used, they can give this nation a long-lasting, competitive advantage in the global marketplace. But beyond economics, there are compelling

reasons to use technology to improve the productivity of education. At the top of the list would be the improvement of instruction through individualized courses, providing drill and practice, maintaining low-enrollment advanced-level classes, extending the use of master teachers and eliminating the barriers of time and distance. As the old refrain goes: "Accentuate the positive and eliminate the negative."

Despite the many warnings that America is in danger of losing its competitive edge to other nations, many Americans do not see the need to employ educational technology in the schools either as a problem or an issue for discussion. Unfortunately, the evidence which clearly indicates that even dramatic improvement in traditional methods cannot possibly close the gap in educational achievement between various ethnic groups or between students who attend greatly different schools falls on deaf ears. The old information-transmission model no longer fits modern society. Classroom lectures are efficient if one wishes to expose students to a great deal of information, but not if one wishes to foster independent thinking, reasoning, analysis and application of knowledge to the problems facing individuals and the nation.

Will school districts be willing to give up their high ratio of allocation of funds to personnel in order to produce a significant increase in technological investment? Will educators and boards of education be willing to adjust their spending patterns to finance the implementation of educational technologies? Traditional low budget items such as textbooks, tests or films cannot begin to cover the change-over costs for sophisticated educational technologies.

Because most school districts independently cannot generate a significant amount of funds for research and development to properly mount a meaningful project, will educators collectively pool their resources to research and develop the

data and the strategies to facilitate new ways of managing schools and delivering instruction?

Will the national government or individual states invest substantially in educational research and development and maintain such funds over time in order to launch and sustain telecommunications systems of the size and universality that will encourage participation and investment on the part of private enterprise?

How best can the results of existing research and experimentation be translated into viable educational policies?

Given the fact that microcomputers are now standard office equipment and personal computers are showing up on more and more individual shopping lists, will the public schools survive and continue to enjoy the support of patrons and parents if they do not make use of the technologies that are widely available in private homes as well as the work place?

Will teachers having labored for years in the classroom and pushed their salaries to a comfortable level willingly surrender their position and relative autonomy to a computer much less to a distant instructor beamed in by satellite?

Will any of those involved live long enough to see public policy catch up with economic reality? Time will tell.

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